HUSBANDRY AND MANAGEMENT GUIDELINES FOR ISLAND FOXES TO BE RE-INTRODUCED TO THE WILD

INTRODUCTION

In June 2004, the Island Fox Integrated Recovery Implementation Team met. At this meeting, a task force was created with the charge of developing a management and husbandry plan for captive foxes. Husbandry recommendations for the permanent captive mainland population of foxes have already been compiled at recent husbandry workshops held at the Santa Barbara Zoological Gardens. Copies of these guidelines can be provided upon request to the Santa Barbara Zoo.

The following husbandry and management guidelines will focus on island foxes that are part of the reintroduction program. These guidelines were developed from information compiled from surveys distributed to all current captive fox locations on the islands. The following islands returned completed surveys: San Nicolas, San Miguel, Santa Rosa, and Santa Cruz. Guidelines specific to subspecies are not deemed necessary at this time. Responses from the surveys indicated there were no special considerations needed for individual subspecies.

These guidelines have been written under the assumption that foxes identified for reintroduction to the wild may be held in a captive setting, at least temporarily, on their native islands or on the mainland. Husbandry and management recommendations have been written to include three different scenarios. The "Islands" scenario is for foxes that are held in captivity on their native island and identified for release. The "Mainland [A]" scenario is for foxes that are housed in captivity on the mainland, identified for release on their native island, and are provided a pre-release acclimation period on the island prior to release. The "Mainland [B]" scenario is for foxes that are housed in captivity on the mainland, identified for release on their native island but are <u>not</u> provided a pre-release acclimation period on the island prior to release.

Foxes identified for release may require alternative husbandry and management guidelines. These training-for-release guidelines will be developed as necessary.

HUSBANDRY AND MANAGEMENT RECOMMENDATIONS

Abiotic Environmental Variables

Temperature:

<u>Islands</u>

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Island foxes housed on their native islands should be kept within normal island temperature ranges. Supplemental heating or cooling should not be necessary.

Mainland [A]

Island foxes housed on the mainland should be kept between 32° and 100° F (0-38 C). (This range incorporates all Channel Island climates.) Although island foxes are able to withstand occasional extremes of temperature, supplemental heating or cooling may be necessary if extreme temperatures persist.

Mainland [B]

Island foxes housed on the mainland should be kept within the normal temperature range for their native island. Supplemental heating or cooling may be necessary to maintain these conditions.

Humidity:

Island foxes do not have specific humidity requirements.

Illumination:

Natural light and light cycles are recommended. For island foxes housed indoors, a day/night cycle of 12 hours light/12 hours dark, or one that matches seasonal changes is advised.

Space

A variety of pen sizes and shapes have been used and proven successful for breeding of island foxes.

Pens currently used to house island foxes range from 120 – 1000 ft^2, though larger pens may be used. Standard 2"x2" chain link or smaller is recommended. If flexible netting (i.e. woven mesh) is used for containment, 1" openings are recommended especially for containment of kits. Ground skirting or underground concrete curbing are necessary to prevent foxes from digging out of pens. Pens should be topped with a material containing openings no larger than 2"x2".

Pen shapes currently used include rectangular, L-shaped, U-shaped, and Z-shaped.

Inter-individual distances

It is recommended that foxes be housed in male-female pairs or same sex pairs. A buffer space is necessary between pairs of foxes. It has been observed that fox pairs housed next to each other, with a common divider between them, will fight. Currently pens are separated by at least 6 feet. This distance between pairs has proven successful for breeding. A minimum distance between pairs where island foxes do not fight or become stressed and provides a successful breeding environment has yet to be determined.

Temporary Separation

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Individuals may need to be separated from other island foxes for an extended period of time and for a variety of reasons. A means of separating and isolating individuals should be available. No accounts of any behavioral challenges have been noted for foxes housed as singles.

Introduction and reintroduction of individuals are typically unproblematic. A protected, mesh-to-mesh visitation opportunity should be provided in order to assess individuals' behavior toward each other before physical contact is allowed. Introduction/reintroduction should be monitored for signs of aggression, displacement, stress, or other behaviors that indicate the two individuals may not do well sharing the same living space.

Females do not need to be isolated prior to or post parturition unless pen mates exhibit behavior that either interferes in the female's ability to care for her young or places the kits' health in danger.

Furnishings

Island foxes are good climbers by nature. Therefore, climbing and above ground resting opportunities should be provided. Items such as plywood, fence panels, logs, trees, PVC pipes, hammocks, and shelves have been provided in the past and utilized by foxes.

Island foxes in the wild are regularly found in dens. Therefore, dens or similar ground level or sub-ground level private resting areas should be provided. Items such as vegetation, teepees, deadfall piles, den/nest boxes, and PVC pipes have been provided in the past and utilized by foxes.

At least one den/nest box should be provided in each pen. Providing multiple den areas allows animals to choose a den site that is most comfortable for them. A variety of den/nest boxes have been provided in the past and all have proven successful for breeding. Currently used boxes range from 30"x42", 30" tall and subdivided into two chambers to 24"x34", 14" tall and subdivided into three chambers including an entry. Some box roofs have overhangs, some boxes are partially buried, and some boxes have multiple entrances. There are some island foxes that do not use boxes provided and prefer to dig their own natural dens. In general, box design does not appear to affect breeding behavior or parturition and each individual fox seems to have its own preference for den sites.

Shelter/shade

Shelter and shade from the elements should be provided at all times. Elements that should be considered when creating sheltered areas include rain, wind, and sun.

Visual, Acoustic, and Olfactory Barriers

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Visual barriers between island foxes within close proximity have proven to be ineffective in reducing stress or aggression between pairs. In situations where foxes have appropriate inter-individual distance between them, visual barriers are not necessary but may have some benefit in reducing stress.
Acoustic and olfactory barriers, other than large inter-individual distance, have not been used with island foxes.

Substrates and bedding materials

Natural soil substrate is recommended for island fox enclosures. Other substrates and bedding materials have been provided; wood shavings, bark chips, mulch, straw, hay, and sand.

Providing bedding material in den/nest boxes is not necessary for pregnant females and may discourage use of the box if the bedding is foreign or disliked by the individual. If bedding is provided, favored bedding types should be identified and used prior to and post parturition.

Enclosure variation

Due to the inquisitive nature of the island fox, it is recommended that pen furniture (i.e. perching, resting platforms, etc.) be rearranged on occasion to provide foxes with an opportunity to explore a "new space". Furniture may be rotated between pens housing healthy foxes to provide stimulation and encourage natural behaviors.

Care should be taken not to disturb favorite den locations, especially prior to and post parturition.

Enclosure Cleaning

It is recommended that pens be cleaned at least 3 times weekly although once daily is preferred. At these times, removal of fecal material, left over food, old enrichment items, and foreign debris should be removed. Hard surfaces used for feeding or those that have been urinated upon, etc. should disinfected as needed.

During breeding season, pen cleaning may be decreased to at least one time weekly. More frequent pen cleaning during this time does not seem to affect how the foxes care for their kits as long as the den site is not disturbed.

Containment

A variety of barriers may be used to contain island foxes including chain link fencing, stainless steel woven mesh, wire mesh, and solid walls of brick, wood, etc. Barriers should be free of protrusions that could cause injury or provide unwanted climbing opportunities.
A top on the enclosure is essential for containment of foxes. Enclosures with either no top or just an overhang (90 degree angle and 18" wide) have not provided adequate containment. It is recommended that enclosures have a

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complete and secure ceiling made of any of the materials listed above to ensure containment.
Either an underground curb or ground skirt is essential to prevent foxes from digging out of the enclosure.

Special consideration is necessary for containment of kits. Kits have been observed fitting through 2"x2" mesh. Therefore, all openings and gaps larger than 1.5" should be covered with shade cloth, hardware cloth, a smaller mesh material. Openings no larger than 1"x1" are recommended for enclosures containing kits.

Biotic Variables

Water

Clean, fresh water should be made available at all times. Water bowls should be disinfected regularly to prevent algae or bacterial build up.

Food

It is recommended that island foxes be fed daily and as close to dusk as possible to mimic their naturally nocturnal habits.

Food presentation

Food may be presented in a bowl, scattered throughout the pen or placed in enrichment feeders. At least one feeding location should be available for each fox within the pen and feeding locations should be separated as much as possible to avoid allowing one individual to dominate all feeding locations

Islands & Mainland [B]

Whilst special effort to keep foxes from associating food with keepers does not seem to affect release success, hand feeding is not recommended.

Mainland [A]

Hand feeding of certain food items may be beneficial to prevent overfeeding and ensure even distribution of favorite items or medications. Hand-feeding should be discontinued once the fox reaches its training-for-release period.

Enrichment

Novel food items may be used as enrichment as well as live insects or other whole prey items. The regular diet may be used in conjunction with non-food enrichment.
Non-food enrichment items that may be provided include: scents (baking spices, perfumes, catnip, etc.), vegetation/browse (fresh herbs, trimmings from non-toxic plants that are not already inside the enclosure, pine cones, etc.), puzzle feeders, Kong toys, PVC tubing, brown paper bags, cardboard boxes, socks, paper towel rolls, etc.

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Caretakers should observe animals when they are given new enrichment items to ensure they are not interacting with them in an unsafe manner. New enrichment ideas should be approved by a veterinarian prior to being given to animals.

Social Considerations

Group size and composition

Island foxes have been housed as singles and pairs of; 1.1, 0.2, or 2.0 (either siblings or at least one castrated male). It is recommended that pairs of 1.1 be maintained as much as possible and that, because of space availability challenges, animals housed as singles be limited.

Groupings that have not been successful in the past include; 1.2, 2.2 and 0.4. In these situations aggression took place between individuals and separation of the group was necessary. Groupings of 0.3 have been successful in one instance.

Human-Animal Interactions

Island foxes tend to be very docile by nature and adapt to human presence easily. Consistency in husbandry practices allows for management with reduced stress to the foxes.

Islands and Mainland [B]

Interaction between keepers and the foxes should be limited. It is recommended that handling of the foxes be limited to emergencies or annual examinations only. The amount of time keepers spend in and around the pens should be kept to a minimum and it is recommended that keepers do not speak to the foxes and that conversations while around the foxes be kept to a minimum.

Mainland [A]

While following the recommendations listed for Islands and Mainland[B] is acceptable, this level of restricted interaction is not necessary for these foxes. Interactions will be more restricted once the fox reaches its training-for-release period.

Nutrition

Diet

There are a variety of diets currently fed to island foxes. They all use dog kibble as the main staple with fruits, vegetables, nuts, and/or whole prey as supplements. Generally, each fox receives 60-70g of dog kibble daily. Various fruits, vegetables, and nuts are added to the diet as well as whole prey items such as small birds, eggs (raw or hardboiled), mice, and insects.

Diet amounts should be modified based on the health, weight, and body condition of each individual fox.

Amounts of whole prey diet may increase during training-for-release period.

Medical management

Quarantine and Hospitalization

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Information regarding quarantine and hospitalization is required from the Veterinary Group of the RCG before recommendations can be made.

Preventative medicine

Information regarding preventative medicine is required from the Veterinary Group of the RCG before recommendations can be made.

Capture and Restraint Techniques

It is recommended that island foxes be captured and restrained using personal protective equipment. Capture techniques that have been effective with island foxes include: trapping in live trap or kennel, netting, and free-hand grabbing with gloved hands.

Grabbing by the scruff seems to be the easiest and most effective method of restraint. Wrapping in a towel is another restraint method that has been successful. It is recommended that island foxes be muzzled if prolonged restraint is necessary. Covering the eyes with a blind may aid in calming a fox during prolonged restraints.

Immobilization

Information regarding immobilization is necessary from the Veterinary Group of the RCG before recommendations can be made.

Pathology Protocols

Information regarding pathology protocols is necessary from the Veterinary Group of the RCG before recommendations can be made.

Reproduction

Seasonality of Reproduction and Development

Island foxes reproduce once annually and are primarily monogamous. Mating usually occurs in February.
Gestation period is 50-53 days.
Young are sexually mature at 10 months of age though very few yearling foxes tend to breed.

Hormonal Tracking as a Mechanism for Identifying Reproductive State

Endocrine assays have been completed on fecal samples from San Miguel Island for 2000 and 2001 breeding seasons. Based on sustained increase in progesterone as an indicator of ovulation, it appears that these females are induced ovulators. Ovulation only occurred for those females housed with males. Cortisol levels, a hormone associated with stress, were not related to the occurrence of ovulations.

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These results are significant because all canids studied to date have been shown to ovulate spontaneously, with ovulation followed by an obligate pseudopregnancy indistinguishable hormonally from pregnancy. In contrast, felids are induced ovulators.

Introduction and/or Separation of Males

Males should not be separated from females prior to or post parturition unless the male is exhibiting behavior that either interferes in the female's ability to care for her young or places the kits' or dam health in danger.

Parturition facilities

Island foxes have been observed utilizing a variety of man-made den boxes as well as digging their own dens. It is recommended that at least one den area be available in order to reduce stress. Providing multiple den areas allows animals to choose a den site that is most comfortable for them.

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Hand-rearing protocols

Information regarding hand-rearing protocols is necessary from the Veterinary Group of the RCG before recommendations can be made.

Contraception

Castration is the only permanent contraceptive method currently in use for island foxes.

There is one case of a contraceptive implant being used on a female member of the permanent captive mainland population.

Behavior Management

Training

Training for routine husbandry and medical purposes is a valuable tool that can aid in the management and husbandry of the island fox. Foxes that are part of the permanent captive mainland population have been trained behaviors such as targeting, stationing, stepping onto a scale, entering a crate or Have-a-Heart trap, and desensitizing to tactile contact behind the head for scruffing.

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Islands and Mainland [B]

Due to the routine and frequent contact necessary for behaviors to be trained, it is not recommended that training of foxes identified for reintroduction take place.

Mainland [A]

While following the recommendations listed for Islands and Mainland[B] is acceptable, it is recommended that the training of behaviors such as crate training, scale training, and targeting be considered in order to provide better husbandry and medical care for these individuals. Training should be discontinued once individuals reach the training-for-release period.

Training-for-release

Once individuals have been identified as candidates for reintroduction to the wild, it is recommended that a training period take place which will aid in successful release. Specifics regarding the timing and length of this training-for-release period have not yet been determined. These guidelines may not have direct affect on the release success rate of the foxes however, they are recommended in order to give individuals the best possible chance at a successful reintroduction.

Keeper/fox interaction: All handling of the individuals should be discontinued except for emergency medical care. The amount of time keepers spend in and around the pen should be kept to a minimum and conversation with or around foxes should be discontinued.

Food: It is recommended that the diet should be modified to mimic what foxes will find in the wild. The feeding of live prey (mice and insects) should be increased to encourage hunting behavior and other diet items should be scattered regularly in order to encourage foraging behavior.

Socialization: It is recommended that individuals, especially young foxes removed from parents, be socialized with the other individuals identified for release within the same area and time period.

Trap conditioning: Individuals should be fed part of their diet inside live traps used for recapture. These traps should be locked open allowing foxes to come and go freely. This will condition the foxes to check these traps for food, allowing easier recapture if/when necessary.

Guidelines may be added as more is learned about what challenges reintroduced foxes face upon release and why some reintroductions are not successful.

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